WHAT IS CLAIMED IS:

1. A waveguide assembly comprising:

a waveguide region comprising:

a longitudinally extending core, wherein the core includes an input channel and at least one output channel; and

a cladding at least partially surrounding the core for confining signals within the core; and

at least one photonic crystal (PhC) region extending laterally through at least a portion of the core to at least partially direct signals propagating through the core.

2. A waveguide assembly according to Claim 1, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a bend for signals propagating through the core.

3. A waveguide assembly according to Claim 2, wherein each PhC region includes a boundary layer at a boundary of the PhC region and the core of the waveguide region, and wherein the boundary layer is capable of being modified to thereby manipulate a diffraction effect caused by a periodicity at the boundary of the at least one PhC region and the core.

4. A waveguide assembly according to Claim 3, wherein the boundary layer of each PhC region comprises an array of a plurality of one of holes and posts, and wherein the boundary layer is capable of being modified by changing at least one of a radius, periodicity and position of the one of holes and posts of the boundary layer.

5. A waveguide assembly according to Claim 1, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a beamsplitter for signals propagating through the core.

6. A waveguide assembly according to Claim 5, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a polarizing beamsplitter for signals propagating through the core.

7. A waveguide assembly according to Claim 6, wherein a portion of the core through which the at least one PhC region extends can be configured to follow a propagation direction of polarized signals propagating through the core.

8. A waveguide assembly according to Claim 7, wherein the at least one output channel comprises first and second output channels, and wherein a portion of the first output channel through which the PhC region extends is sloped with respect to the input channel.

9. A waveguide assembly according to Claim 1, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a Mach-Zender interferometer for signals propagating through the core.

10. A waveguide assembly according to Claim 1, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a ring resonator for signals propagating through the core.

11. A waveguide assembly according to Claim 1, wherein the at least one PhC region further extends laterally through at least a portion of the cladding such that the at least one PhC region is capable of covering the incident light mode width of a signal propagating through the waveguide region.

12. A waveguide assembly according to Claim 1, wherein signals having a wavelength outside a band gap of the at least one PhC region are capable of propagating through the core.

13. A waveguide assembly comprising:

a waveguide region including a longitudinally extending core; and

at least one photonic crystal (PhC) region extending laterally through at least a portion of the core to at least partially direct signals propagating through the core, wherein the signals are capable of having a wavelength outside a band gap of the at least one PhC region.

14. A waveguide assembly according to Claim 13, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a bend for signals propagating through the core.

15. A waveguide assembly according to Claim 14, wherein each PhC region includes a boundary layer at a boundary of the PhC region and the core of the waveguide region, and wherein the boundary layer is capable of being modified to thereby manipulate a diffraction effect caused by a periodicity at the boundary of the at least one PhC region and the core.

16. A waveguide assembly according to Claim 15, wherein the boundary layer of each PhC region comprises an array of a plurality of one of holes and posts, and wherein the boundary layer is capable of being modified by changing at least one of a radius, periodicity and position of the one of holes and posts of the boundary layer.

17. A waveguide assembly according to Claim 13, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a beamsplitter for signals propagating through the core.

18. A waveguide assembly according to Claim 17, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a polarizing beamsplitter for signals propagating through the core.

19. A waveguide assembly according to Claim 18, wherein a portion of the core through which the at least one PhC region extends can be configured to follow a propagation direction of polarized signals propagating through the core.

20. A waveguide assembly according to Claim 19, wherein the at least one output channel comprises first and second output channels, and wherein a portion of the first output channel through which the PhC region extends is sloped with respect to the input channel.

21. A waveguide assembly according to Claim 13, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a Mach-Zender interferometer for signals propagating through the core.

22. A waveguide assembly according to Claim 13, wherein the at least one PhC region extends laterally through at least a portion of the core to thereby form a ring resonator for signals propagating through the core.

23. A waveguide assembly according to Claim 13, wherein the waveguide region further includes a cladding at least partially surrounding the core for confining signals within the core, wherein the at least one PhC region further extends laterally through at least a portion of the cladding such that the at least one PhC region is capable of covering the incident light mode width of a signal propagating through the waveguide region.

24. A waveguide assembly comprising:

a waveguide region; and

at least one photonic crystal (PhC) region extending laterally through at least a portion of the waveguide region to at least partially direct signals propagating through the waveguide region, wherein the at least one PhC region extends laterally through at least a portion of the waveguide region such that the at least one PhC region is further capable of

covering the incident light mode width of a signal propagating through the waveguide region.

25. A waveguide assembly according to Claim 24, wherein the at least one PhC region extends laterally through at least a portion of the waveguide region to thereby form a bend for signals propagating through the waveguide region.

26. A waveguide assembly according to Claim 25, wherein the waveguide region includes a longitudinally extending core, wherein each PhC region includes a boundary layer at a boundary of the PhC region and the core of the waveguide region, and wherein the boundary layer is capable of being modified to thereby manipulate a diffraction effect caused by a periodicity at the boundary of the at least one PhC region and the core.

27. A waveguide assembly according to Claim 26, wherein the boundary layer of each PhC region comprises an array of a plurality of one of holes and posts, and wherein the boundary layer is capable of being modified by changing at least one of a radius, periodicity and position of the one of holes and posts of the boundary layer.

28. A waveguide assembly according to Claim 24, wherein the at least one PhC region extends laterally through at least a portion of the waveguide region to thereby form a beamsplitter for signals propagating through the waveguide region.

29. A waveguide assembly according to Claim 28, wherein the at least one PhC region extends laterally through at least a portion of the waveguide region to thereby form a polarizing beamsplitter for signals propagating through the waveguide region.

30. A waveguide assembly according to Claim 29, wherein the waveguide region includes a longitudinally extending core, wherein a portion of the core through which the at least one PhC region extends can be configured to follow a propagation direction of polarized signals propagating through the core.

31. A waveguide assembly according to Claim 30, wherein the core of the waveguide region includes an input channel and first and second output channels, and wherein a portion of the first output channel through which the PhC region extends is sloped with respect to the input channel.

32. A waveguide assembly according to Claim 24, wherein the at least one PhC region extends laterally through at least a portion of the waveguide region to thereby form a Mach-Zender interferometer for signals propagating through the waveguide region.

33. A waveguide assembly according to Claim 24, wherein the at least one PhC region extends laterally through at least a portion of the waveguide region to thereby form a ring resonator for signals propagating through the waveguide region.

34. A waveguide assembly according to Claim 24, wherein signals having a wavelength outside a band gap of the at least one PhC region are capable of propagating through the waveguide region.